

Appl. No. : 10/822,424
Filed : April 12, 2004

AMENDMENTS TO THE CLAIMS

Claims 1-22 were pending prior to the entry of these amendments. Please amend Claims 1, 3-7, 13, and 16-18 as indicated below. Please cancel Claims 2, 8-12, 15, and 19-22 without prejudice. Please add new Claims 23-33.

1. **(Currently Amended)** An apparatus for electropolishing a conductive layer on a wafer using a solution, the apparatus comprising:

an electrode assembly configured to be immersed in ~~[[the]]~~ a solution and configured to be positioned proximate to ~~[[the]]~~ a conductive layer on a wafer in contact with said solution, the electrode assembly configured to have ~~having~~ a longitudinal dimension extending to at least a periphery of ~~[[the]]~~ a wafer, the electrode assembly including:

~~[[an]]~~ a first elongated contact electrode ~~configured to receive a potential difference;~~

~~[[an]]~~ a first isolator including a side adjacent to the first elongated contact electrode; ~~[[and]]~~

~~[[an]]~~ a first elongated process electrode including a side adjacent to an opposite side of the isolator configured to receive the potential difference, the first isolator protruding above top surfaces of the first elongated contact electrode and the first elongated process electrode; ~~[[and]]~~

a second elongated contact electrode;

a second isolator including a side adjacent to the second elongated contact electrode;

a second elongated process electrode including a side adjacent to an opposite side of the second isolator, the second isolator protruding above top surfaces of the second elongated contact electrode and the second elongated process electrode; and

a third isolator between a side of the first elongated process electrode and a side of the second elongated process electrode, the third isolator protruding above the elongated contact electrodes and the elongated process electrodes, wherein the

first elongated contact electrode, the first isolator, the first elongated process electrode, the second elongated contact electrode, the second isolator, the second elongated process electrode, and the third isolator are fastened together by at least one fastener; and

a voltage supply configured to ~~supply the~~ apply a potential difference between the contact electrodes ~~[[electrode]]~~ and the process electrodes ~~[[electrode]]~~ to electropolish the conductive layer on the wafer, wherein the isolators are configured to prevent the contact electrodes and the process electrodes from physically contacting said wafer.

2. (Canceled)

3. (Currently Amended) The apparatus of claim 1, wherein the ~~electrode assembly includes~~ isolators each include a plurality of passages configured to ~~provide~~ allow a solution to flow through the electrode assembly.

4. (Currently Amended) The apparatus of claim 1, wherein the electrode assembly includes: ~~a plurality of elongated contact electrodes, isolators, and elongated process electrodes~~

a third elongated contact electrode;

a third fourth including a side adjacent to the third elongated contact electrode;

a third elongated process electrode including a side adjacent to an opposite side of the third isolator, the fourth isolator protruding above top surfaces of the third elongated contact electrode and the third elongated process electrode; and

a fifth isolator between a side of the second elongated process electrode and a side of the third elongated contact electrode, the fourth isolator protruding above the elongated contact electrodes and the elongated process electrodes, wherein the voltage supply is also configured to apply the potential difference between the third contact electrode and the third process electrode.

5. (Currently Amended) The apparatus of claim ~~[[4]]~~ 1, further comprising a mechanism configured to produce relative motion between the electrode assembly and ~~[[the]]~~ a conductive layer on a wafer, which provides electropolishing of ~~wherein motion of said wafer across the elongated process electrodes is configured to electropolish~~ substantially an entire surface of ~~[[the]]~~ said conductive layer.

Appl. No. : 10/822,424
Filed : April 12, 2004

6. (Currently Amended) The apparatus of claim 5, wherein the mechanism is configured to produce ~~produces~~ reciprocating motion between the electrode assembly and ~~[[the]]~~ a conductive layer on ~~the workpiece~~ a wafer.

7. (Currently Amended) The apparatus of claim 5, wherein the mechanism is configured to produce ~~produces~~ rotational motion between the electrode assembly and ~~[[the]]~~ a conductive layer on ~~the workpiece~~ a wafer.

8. (Canceled)

9. (Canceled)

10. (Canceled)

11. (Canceled)

12. (Canceled)

13. (Currently Amended) A system for electropolishing a conductive layer on a wafer using a solution, the system comprising:

a workpiece holder configured to hold ~~the wafer exposing the~~ a wafer and to expose a conductive layer on said wafer to ~~[[the]]~~ a solution;

an electrode assembly configured to be immersed in ~~[[the]]~~ said solution, the electrode assembly configured to be positioned proximate to the conductive layer and configured to extend ~~extending~~ past a periphery of the wafer, the electrode assembly including:

a plurality of elongated contact electrodes configured to receive a potential difference;

a plurality of elongated process electrodes ~~adjacent the plurality of elongated contact electrodes~~ alternatingly interposed among the plurality of elongated contact electrodes, each elongated process electrode configured to receive ~~[[the]]~~ an opposite potential difference; ~~[[and]]~~

~~a plurality of isolators adjacent~~ an insulation separating each of the plurality of elongated contact electrodes and the plurality of ~~from adjacent ones of the elongated process electrodes and configured to insulate the potential difference between the plurality of elongated contact electrodes and the plurality of elongated process electrodes~~; and

Appl. No. : 10/822,424
Filed : April 12, 2004

a plurality of compressible strips disposed above the each of the insulation members and between each of the elongated contact electrodes and the elongated process electrodes, top surfaces of the compressible strips being substantially coplanar; and

a voltage supply configured to supply the apply a potential difference between at least some of the contact electrodes and at least some of the process electrodes to electropolish the conductive layer on the wafer, the insulation members configured to electrically insulate the plurality of elongated contact electrodes from the plurality of elongated process electrodes during application of said potential difference.

14. (Original) The system of claim 13, wherein the elongated contact electrodes and the elongated process electrodes are configured to electropolish the conductive layer on the wafer without physical contact with the wafer.

15. (Canceled)

16. (Currently Amended) The system of claim 13, further comprising a mechanism configured to produce relative motion between the electrode assembly and the conductive layer on the wafer, which provides electropolishing on wherein motion of said wafer across the elongated process electrodes is configured to electropolish substantially an entire surface of ~~[[the]]~~ said conductive layer.

17. (Currently Amended) The system of claim 13, wherein the workpiece holder is configured to produce rotational motion between the electrode assembly and the conductive layer on the ~~workpiece~~ wafer.

18. (Currently Amended) The system of claim 13, wherein~~[[:]~~

~~the power supply is configured to supply a first potential and a second potential difference; and~~

the electrode assembly includes:

a first group ~~[[of]]~~ comprising a plurality of said elongated contact electrodes, ~~isolators,~~ insulation members, compressible strips, and elongated process electrodes, the first group defining a first zone, the elongated contact electrodes and the elongated process electrodes of the first group of plurality ~~elongated contact electrodes and elongated process electrodes~~ configured to

Appl. No. : 10/822,424
Filed : April 12, 2004

receive ~~[[the]]~~ a first potential difference to electropolish a conductive layer on a wafer at a first rate; and

a second group ~~[[of]]~~ comprising a plurality of said elongated contact electrodes, isolators, insulation members, compressible strips, and elongated process electrodes, the second group defining a second zone,[[;]] the elongated contact electrodes and the elongated process electrodes of the second group ~~of plurality of elongated contact electrodes and elongated process electrodes~~ configured to receive ~~[[the]]~~ a second potential difference to electropolish said conductive layer on said wafer at a second rate different from the first rate.

19. (Canceled)

20. (Canceled)

21. (Canceled)

22. (Canceled)

23. (New) The apparatus of claim 1, wherein the fastener comprises a pin extending through transverse holes in the elongated contact electrodes, the isolators, and the elongated process electrodes.

24. (New) The apparatus of claim 1, wherein the third isolator is adjacent to a side of the first elongated process electrode and a side of the second elongated contact electrode.

25. (New) The apparatus of claim 1, wherein the third isolator is adjacent to a side of the first elongated process electrode and a side of the second elongated process electrode.

26. (New) The apparatus of claim 13, wherein the compressible strips each comprise a material having a closed pore structure configured to prevent solution from flowing through the insulation members and the compressible strips.

27. (New) The apparatus of claim 26, wherein the insulation members and the compressible strips each include a plurality of openings extending through the insulation members and the compressible strips, the openings configured to allow a solution to flow through the electrode assembly.

28. (New) The apparatus of claim 26, wherein the elongated contact electrodes and the elongated process electrodes each include a plurality of grooves extending through the

Appl. No. : 10/822,424
Filed : April 12, 2004

elongated contact electrodes and the elongated process electrodes, the grooves configured to allow a solution to flow through the electrode assembly.

29. (New) The apparatus of claim 13, wherein each of the compressible strips protrudes between about 1 and 10 mm above the top surfaces of the elongate contact electrodes and the elongate process electrodes.

30. (New) The apparatus of claim 13, wherein each of the compressible strips protrudes between about 2 and 5 mm above the top surfaces of the elongate contact electrodes and the elongate process electrodes.

31. (New) The apparatus of claim 13, wherein the elongate contact electrodes, the insulation members, and the elongate process each have an axis of elongation and a width transverse to the axis of elongation and parallel to a plane defined by the axes of elongation, the widths between about 1 and 10 mm.

32. (New) The apparatus of claim 18, wherein the voltage supply comprises a first power source and a second power source, wherein the first power source is configured to apply the first potential difference and wherein the second power source is configured to apply the second potential difference, the first potential difference different from the second potential difference.

33. (New) The apparatus of claim 13, wherein the top surfaces of the compressible strips are configured to contact the conductive surface of the wafer.

34. (New) The apparatus of claim 33, wherein the top surface of each of the compressible strips is abrasive.